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Sekine et al.

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[54] **ACCESS PORT FOR USE IN MEDICAL VESSEL**

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[51] **Int. Cl.**[6] **A61G 11/00**

[52] **U.S. Cl.** **600/22**; 600/21

[58] **Field of Search** 600/21, 22; 220/334, 220/360, 367.1

[56] **References Cited**

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[57] **ABSTRACT**

An access port for use in a medical vessel comprises an inner frame **(15)** detachably mounted on an opening of a transparent hood **(13)** of the infant incubator. An outer frame **(16)** is slidably engaged to said inner frame **(15)**. A flexible sheet **(14)** has one end connected to said inner frame **(15)** and another end connected to said outer frame **(16)**. It is characterized in that a stopper **(36)** is carried by said outer frame **(16)**.

Another access port for use in a medical vessel comprising: a frame **(52)** having an opening **(56)**; a horseshoe plate **(58)** pivotally supported on the frame **(52)** to open or close said opening **(56)**; a lock mechanism **(78)** for locking said horseshoe plate **(58)** in situ which is closed; an inner side **(66)** provided on the horseshoe plate **(58)**; a plurality of resilient pieces **(72)** mounted to said horseshoe plate **(58)** to close said inner side **(66)**; and a holding means **(74)** provided on the horseshoe plate **(58)** to hold a member inserted through said plurality of resilient pieces **(72)**.

3 Claims, 7 Drawing Sheets

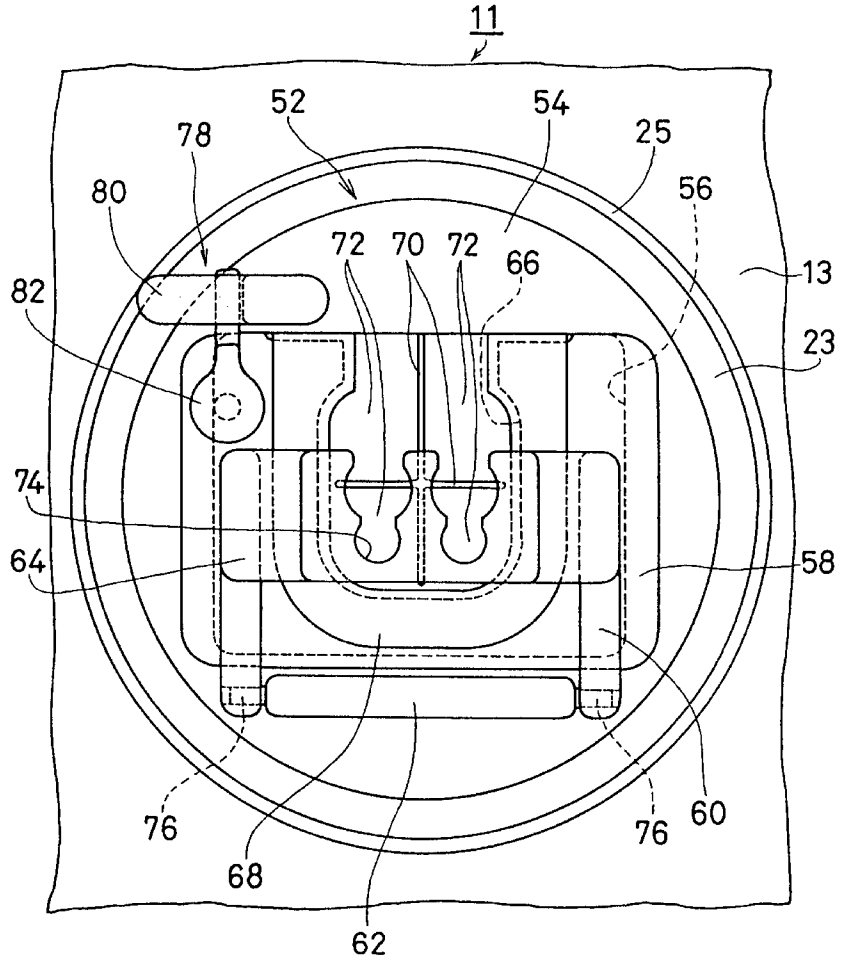


FIG. 1

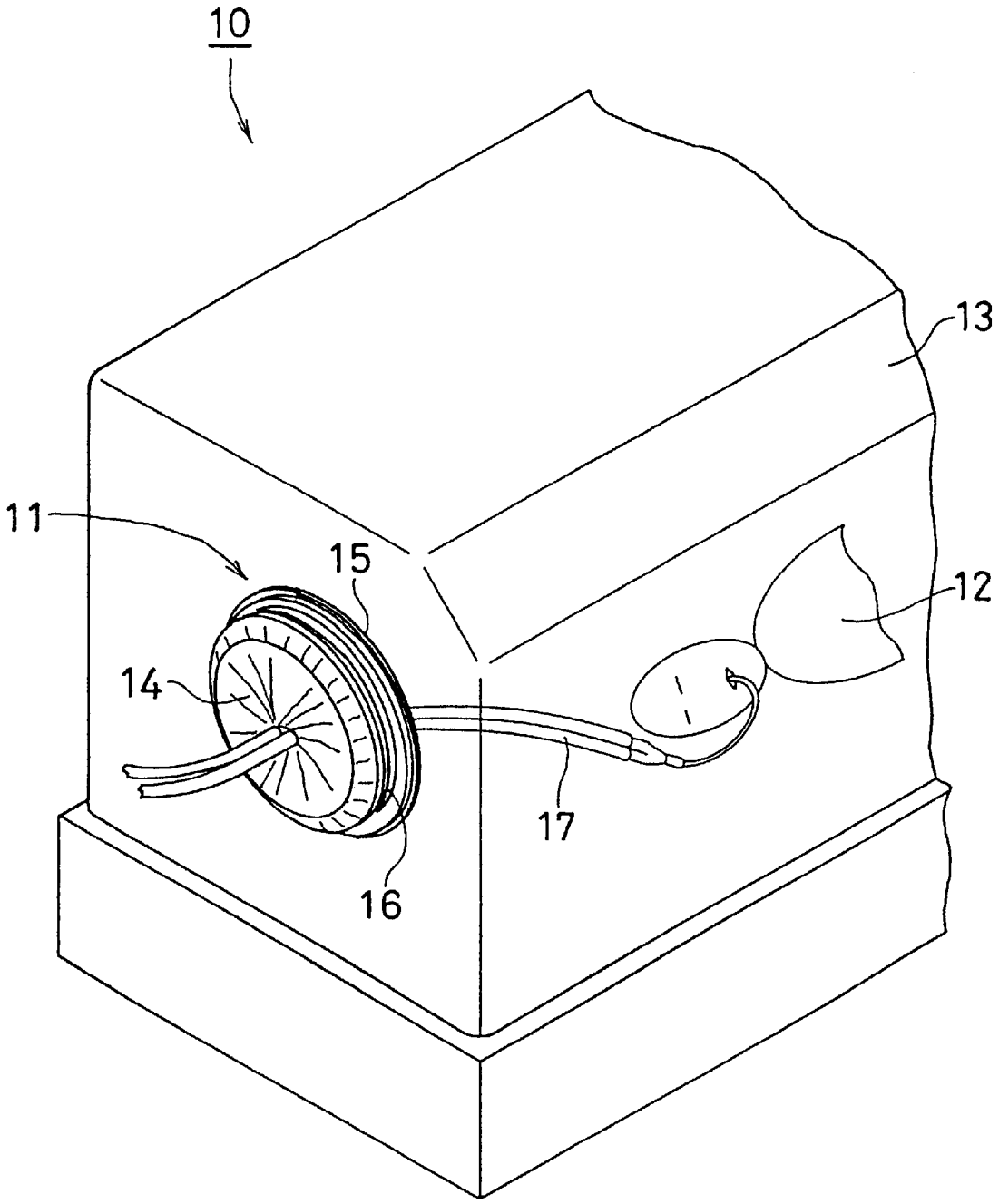


FIG. 2

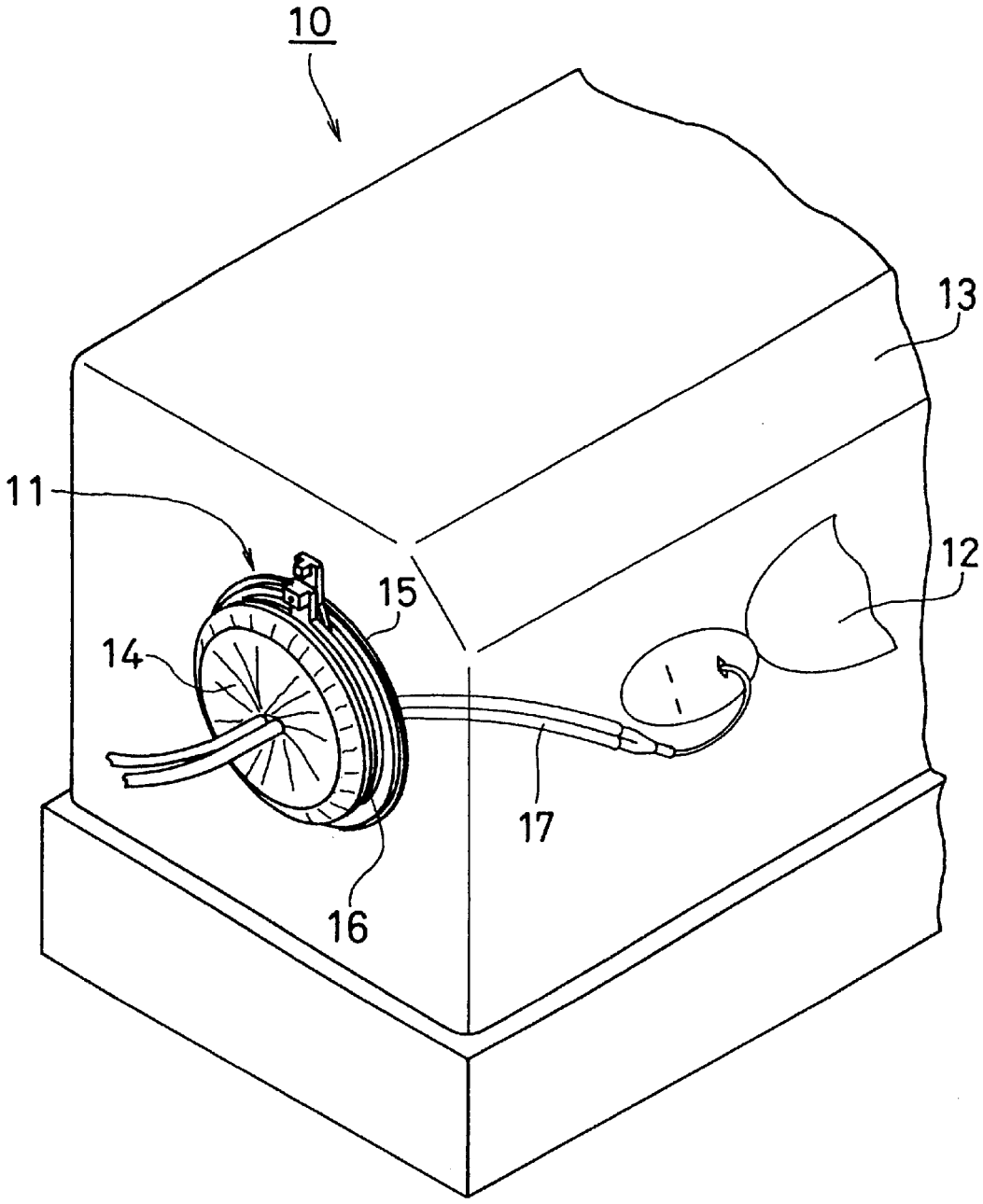


FIG. 3

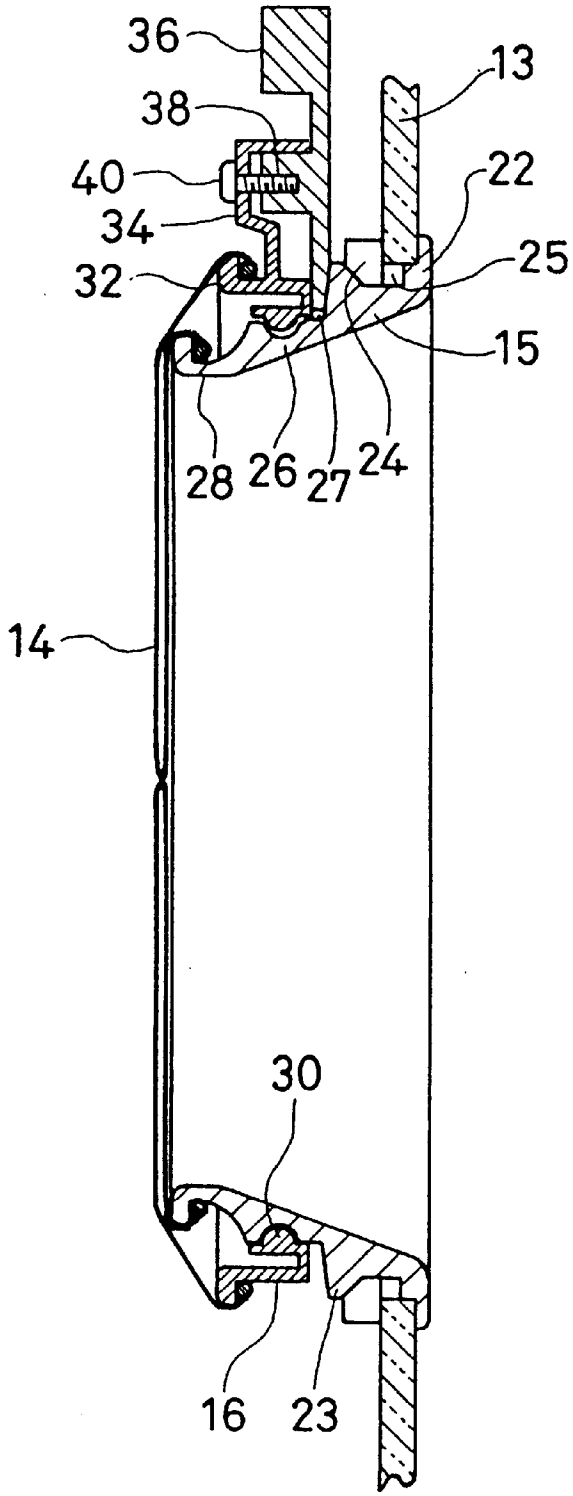


FIG. 4a

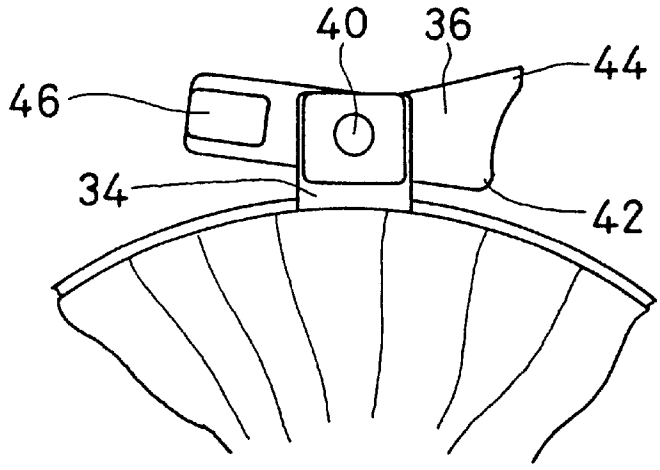


FIG. 4b

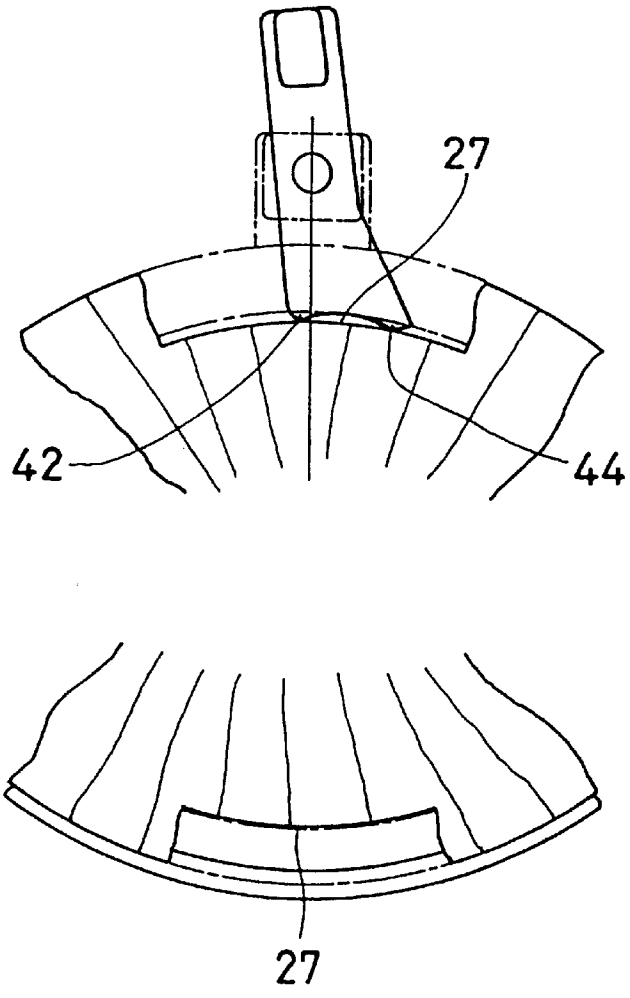


FIG. 5

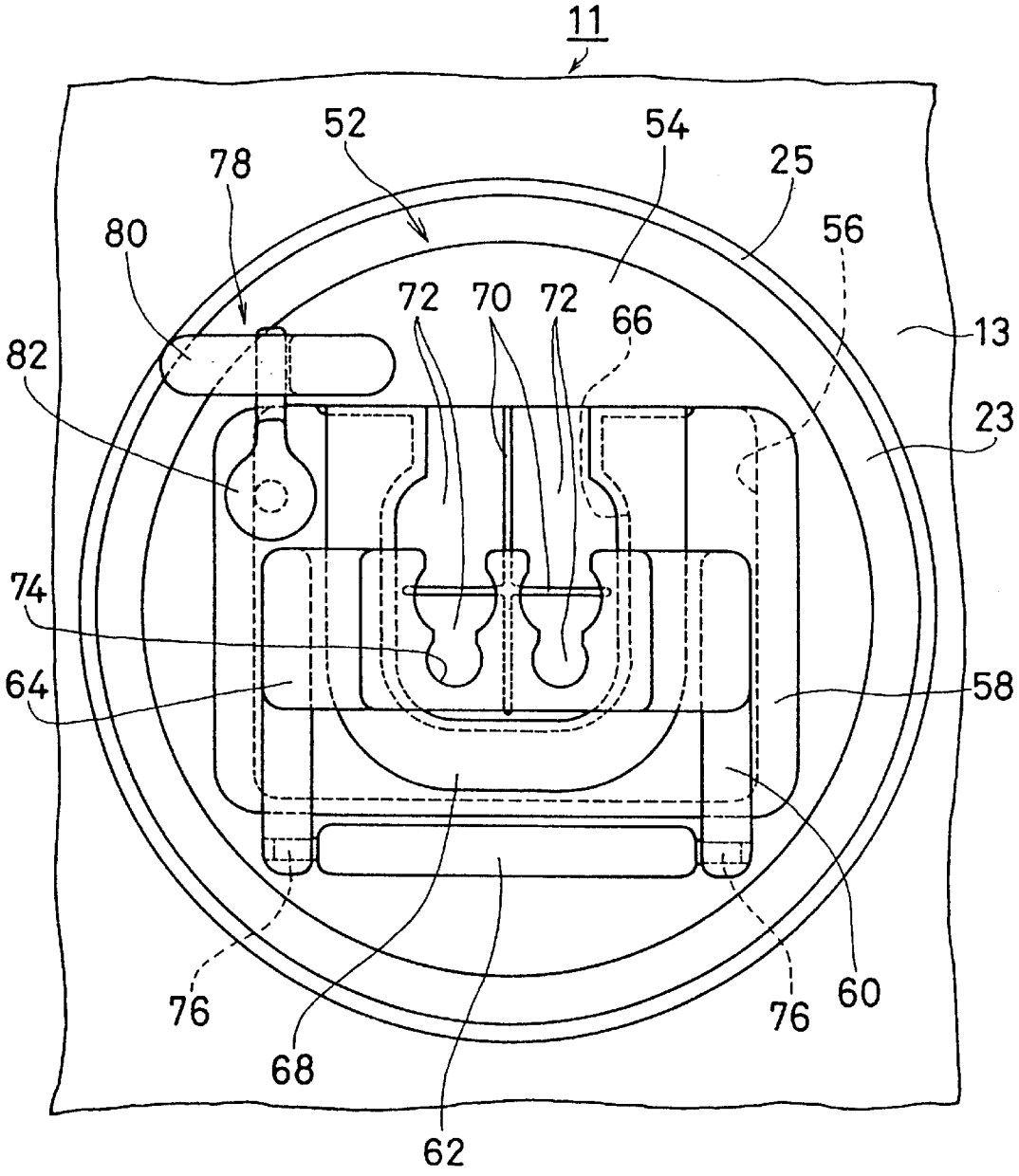


FIG. 6

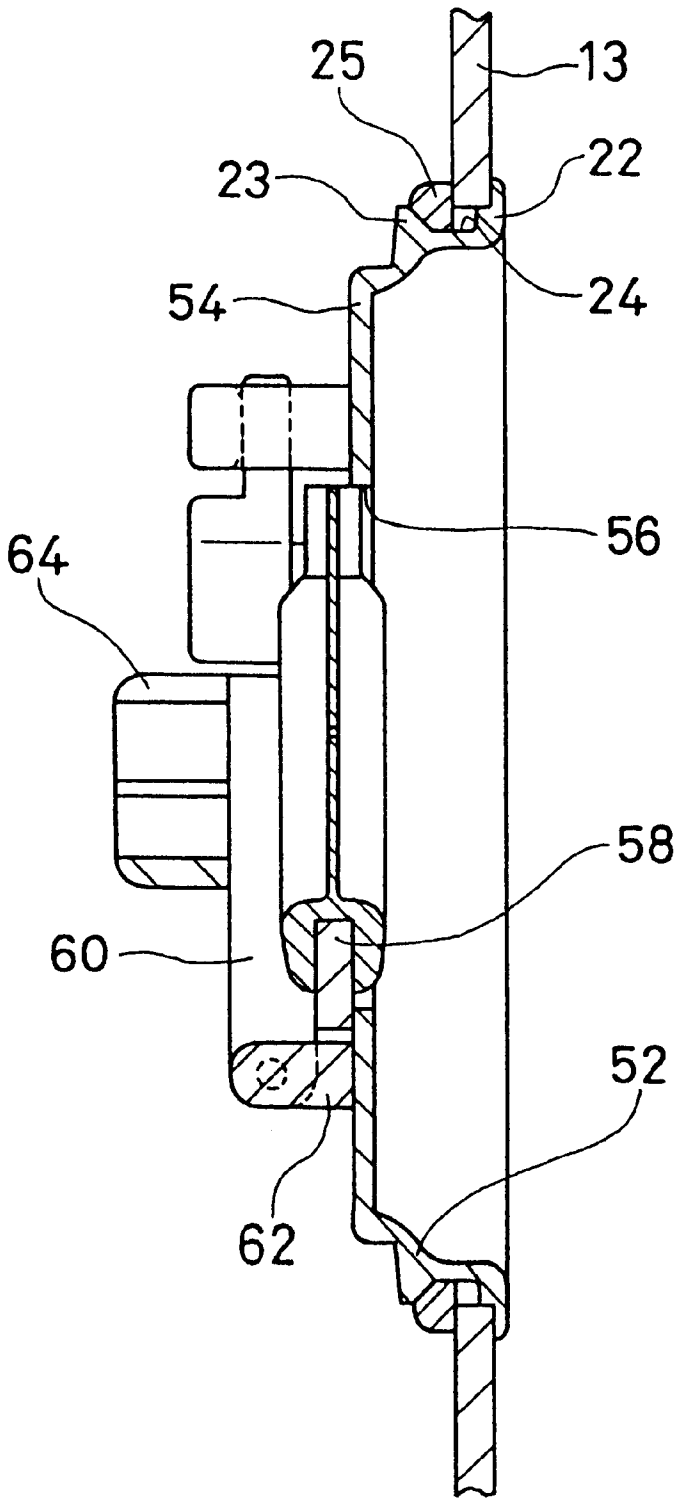


FIG. 7

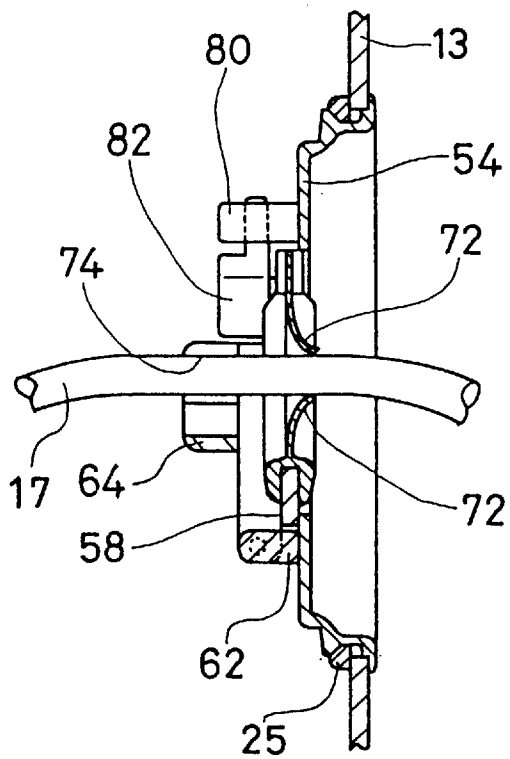
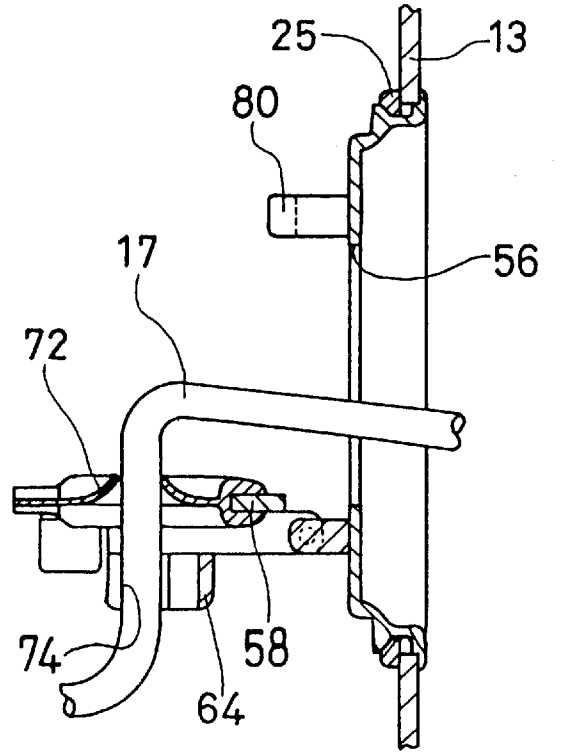


FIG. 8



ACCESS PORT FOR USE IN MEDICAL VESSEL

The present invention relates to an access port for use in a medical vessel such as an infant incubator which receives a premature baby.

BACKGROUND OF THE INVENTION

In a conventional infant incubator as shown in FIG. **1**, an access port **11** is used to nurse a premature baby **12** so that a nurse's hand (not shown) is accessed in the space partitioned by a transparent plate or hood **13**. This access port **11** comprises a tubular flexible sheet **14** folded at about half portion in length, an inner frame **15** mounted to the hood **13** and receiving at its inner rim of the flexible sheet **14**, and a rotatable outer frame **16** concentrically movably disposed on the inner frame **15** and receiving at its outer rim of the flexible sheet **14** to adjust the opening degree of the access port **11** by squeezing the flexible sheet **14** by the rotation of the outer frame **16**.

In the access port **11**, the closed sheet **14** can support a medical tube **17** to be inserted. For example, after an artificial respiration tube **17** or cables (not shown) of an electrocardiogram are attached to a mouth or other body portions of the premature baby **12** in the infant incubator **10** through the access port **11** and the access port **11** is then closed, the inner space of the infant incubator **10** is substantially isolated from the outer space or atmosphere. Then, the desirable medical treatment is performed without disturbing the inner space of the infant incubator.

This access port **11** is so assembled that the outer frame **16** is easily rotated on the inner frame **15** to easily and rapidly access the premature baby **12** mentioned the above.

However, the easy and rapid access through the access port **11** causes the temperature or humidity control in the inner space to be more difficult since it is difficult to retain the outer frame **16** at an arbitrary position against the inner frame **15**. Therefore, the access port **11** is apt to be opened by the self-weight or movement of the respiration tube **17** or cable even if the flexible sheet **14** is squeezed to be completely closed when the respiration tube **17** is inserted into the infant incubator **10** through the access port **11**.

For example, when the medical treatment or monitoring of the premature baby **12** in the infant incubator is performed, the respiration tube **17** or cables are attached to the premature baby **12** through the access port **11**. The access port **11** is closed to isolate the inner space from the ambience after the respiration tube **17** or cables are attached. However, the flexible sheet **14** of the access port **11** must be able to support the weight of mainly the respiration tube **17** and outer force due to the movement or offset of the respiration tube **17** or cables which is generated by the movement of the premature baby **12**, or uncarefullnesss of the nurse or doctor walked around the infant incubator. When the outer force is applied to the flexible sheet **14** of the access port **11**, the outer frame **16** is rotated to open the flexible sheet **14** of the access port **11**. Then, it is necessary to frequently confirm or monitor the condition of the access port **11** and then adjust the access port **11** to be closed as necessary. If this adjustment to the access port **11** is not frequently performed, the access port **11** is apt to be gradually opened to leak the controlled air in the infant incubator to an unpermitable level.

BRIEF SUMMARY OF INVENTION

It is an object of the present invention to provide an access port which firmly retains its outer frame against its inner frame while the outer frame is easily moved on the inner frame.

It is another object of the present invention to provide an access port by which members such as a respiration tube or cables can be firmly supported.

According to the present invention, an access port for use in medical vessel comprises: an inner frame **15** detachably mounted on an opening of a transparent hood **13** of the infant incubator; an outer frame **16** slidably engaged with said inner frame **15**; and a flexible sheet **14** having one end connected to said inner frame **15** and another end connected to said outer frame **16**, and characterized by a stopper **36** carried by said outer frame **16**.

The stopper may be pivotally supported on said outer frame **(16)** and has a lever configuration whose top portion abuts to said inner frame **(15)**.

The outer frame **(16)** preferably has a knob to rotate said outer frame **(16)** and said stopper includes a lever pivotally supported on said knob.

It is also preferable that said outer frame **(16)** has a ring configuration, said inner frame **(15)** has a cylindrical portion slidably engaged on said outer frame **(16)**, said stopper **(36)** includes a first corner contacted and then pressed to the cylindrical portion upon pivoting, and a second corner pressed to the cylindrical portion as well as said first corner.

According to another aspect of the present invention, an access port for use in a medical vessel comprising: a frame having an opening; a horseshoe plate pivotally supported on the frame to open or close said opening; a lock mechanism for locking said horseshoe plate in situ which is closed; an inner side provided on the horseshoe plate; a plurality of resilient pieces mounted to said horseshoe plate to close said inner side; and a holding means provided on the horseshoe plate to hold a member inserted through said plurality of resilient pieces.

BRIEF DESCRIPTION OF DRAWINGS

The foregoing and other objects, features and advantages of the invention will become more apparent upon a reading of the following detailed description and drawing, in which:

FIG. **1** shows a partial perspective view of a conventional infant incubator;

FIG. **2** shows a partial perspective view of the infant incubator in which an access port according to the present invention is mounted on a hood thereof;

FIG. **3** shows a cross sectional view of the access port of FIG. **2** at its lock position;

FIG. **4***a* shows a partial front view of the access port of FIG. **2** at its release position;

FIG. **4***b* shows a partial front view of the access port of FIG. **3**;

FIG. **5** shows a front view of a second embodiment of the access port according to the present invention;

FIG. **6** shows a side view of the access port taken in A—A line of FIG. **5**; and

FIGS. **7** and **8** are cross sectional views of the access port of FIG. **5** at open and close positions, respectively.

DETAILED DESCRIPTION

FIG. **2** shows a partial perspective view of an infant incubator **10** in which an access port **11** according to the present invention is provided on a hood **13** thereof. For example, an artificial respiration tube **17** is inserted to the mouth of the premature baby **12** through the access port **11**.

FIG. **3** shows a cross sectional view of the access port **11**. In FIGS. **2** and **3**, similar or same members corresponding to those of FIG. **1** are denoted same numerals, respectively.

In these drawings, the access port **11** is detachably mounted on an opening of a hood **13** of the infant incubator **10**. This access port **11** comprises a cylindrical inner frame **15** moulded by a plastic material and detachably mounted on the opening of the hood **13**. The inner frame **15** includes a circular flange **22** having a ring portion abutted to the hood **13** adjacent to the opening and a cylindrical portion **23** protruded from the opening when the inner frame **15** is inserted from inside of the hood **13**. The flange **22** has then an outer diameter larger than that of the opening. A circular groove **24** is provided on the cylindrical portion **23** integral to the ring portion. An O-ring or snap ring **25** having an outer diameter larger than the diameter of the opening of the hood **13** is fitted between the circular groove **24** and the hood **13** adjacent to the opening to secure the inner frame **15** to the hood **13**. Then, the snap ring **25** has an inner diameter smaller than an outer diameter of the circular groove **24** to serve as a retaining ring.

The inner frame **15** includes a circular guide groove **26** provided on a cylindrical surface **27** whose diameter is smaller than that of the cylindrical portion **23**, and a circular hook **28** sealingly covered by a rubber contained inner rim of the cylindrical flexible sheet or cloth **14**. Then, the flange **22**, the cylindrical portion **23** and the hook **28** are integrally moulded in the inner frame **15**. The flexible sheet or cloth **14** is sealingly finely woven or coated by sealing additives to provide its airproof.

The outer frame **16** has a ring configuration moulded by a plastic material and a circular channel groove opened at front side is provided and extending toward its axis direction to define outer and inner cylindrical surfaces.

A circular projection **30** is integrally provided on the inner cylindrical surface of the outer frame **16** to slidably engaged on the guide groove **26**. The outer frame **16** is snapped to the concentric inner frame **15** so that the circular projection **30** is loosely engaged to the guide groove **26** to smoothly carry or rotate the outer frame **16**. A gap is provided between the back of the outer frame **16** and the cylindrical portion **23** to partially expose the cylindrical surface **27**.

The outer frame **16** includes a circular hook **32** integral to the outer cylindrical surface thereof and sealingly covered by a rubber contained outer rim of the cylindrical flexible sheet **14** after being folded at about half portion in length. A knob **34** is integrally provided on the outer cylindrical surface of the outer frame **16** to allow the manual rotation of the outer frame **16**. A stopper **36** moulded by a plastic material is pivotally supported on the integral knob **34** to enable the rotation of the outer frame **16** or disable the rotation thereof by the increase of the friction between the inner and outer frames **15** and **16**.

FIGS. **4***a* and **4***b* show a partial front view of the access port **11** for describing the action of the stopper **36** in detail. The stopper **36** has a lever configuration and includes a central hole **38** (FIG. **3**) tapped by a tapping screw **40**, two corners **42** and **44** each provided on one side of the lever, and another knob **46** provided on another side thereof to be manually pivoted. The corners **42** and **44** have a thickness smaller than the gap between the outer frame **16** and the cylindrical portion **23**. The first corner **42** is abutted or pressed to the cylindrical surface **27** of the inner frame **15** upon pivoting the stopper **36** adjacent to its dead point between an axis of the hole **38** or screw **40** and coaxes of the frames **15** and **16**. The second corner **44** is pressed to the cylindrical surface **27** to limit the rotation thereof over the dead point.

The stopper **36** pivots from the release position as shown in FIG. **4***a* to the lock position as shown in FIG. **4***b* in which the outer frame **16** is held or stopped against the inner frame **15** at the arbitral position. The stopper **36** is so constructed that its lock position is held or latched without another mechanism. Then, the lengths of two corners **42** and **44** from the axis of the hole **38** or screw **40** are determined longer than the length between the axis of the hole **38** and the cylindrical surface **27** of the inner frame **15** under the release position.

Therefore, when the stopper **36** is rotated or pivoted in a clockwise direction, the first corner **42** is initially contacted to the cylindrical surface **27** to generate a first friction force on the opposite or bottom side of mainly the guide groove **26** against the projection **30**.

When the stopper **36** is further pivoted in the clockwise direction to its dead point, the first corner **42** is pressed to the cylindrical surface **27** to generate a maximum friction force on the bottom side of the guide groove **26** against the projection **30**.

When the stopper **36** is furthermore pivoted in the clockwise direction passing through the dead point, the first corner **42** as well as the second corner **44** is pressed to the cylindrical surface **27** as shown in FIG. **4***b* to generate a second friction force slightly lighter than the maximum friction force on the bottom side of the guide groove **26** against the projection **30**, and the outer frame **16** is held on the inner frame **15** in situ.

Therefore, the length of the corner **42** from an axis of the hole **38** is determined slightly longer than the distance between an axis of the outer frame **16** and the hole axis of the knob **34** subtracted by a radius of the cylinder surface **27** and by an offset or tolerance of frames **15** and **16**. The length of the corner **44** from an axis of the hole **38** is also determined slightly longer than or equal to that of the corner **42**.

Accordingly, when the respiration tube **17** is inserted into the infant incubator **10**, the outer frame **16** is then rotated in the clockwise direction to close the flexible sheet **14**, and the stopper **36** is pivoted in the clockwise direction to the lock position, the flexible sheet does not opened because the outer frame **16** is not rotated in an anti-clockwise direction even if the self-weight of the respiration tube **17** or the outer force by the movement thereof is applied to the flexible sheet **14**. Then, the access port **11** can be substantially sealed while entering the respiration tube **17**.

In another embodiment, a plurality of radial slits may be provided with the circular projection **30** integral to the inner cylindrical surface of the outer frame **16** to define individually deformed projection pieces to easily snap the outer frame **16** into the inner frame **15**.

The flexible sheet **14** may be provided in a cylindrical configuration by the nylon woven cloth or nonwoven cloth having flexibility, and rubber rings are stitched in the end portions thereof. Therefore, the flexible sheet **14** can be sealingly mounted to the hooks of the inner and outer frames **15** and **16**, and easily removed therefrom. On each hooks **28** and **33**, additional cap rings may be applied to tightly seal their end portions. The hook **28** of the inner frame **15** may be protruded from the hook **32** of the outer frame **16** to mount or unmount the flexible sheet **14** under the condition that the inner frame **15** is assembled to the outer frame **16**.

In the above embodiment, the stopper **36** having an axis parallel to the coaxes of the frames **15** and **16** is described. A modification among others may be made with a stopper having an axis perpendicular to the coaxes of the frames **15** and **16**. This stopper having a channel configuration has a central hole pivotally supported between two uprights inte-

gral to the knob **34** of the outer frame **16** through a shaft perpendicular to the coaxes of frames **15** and **16**. The stopper includes a back teeth meshed with a gear on the cylindrical surface **27** and a front button manually pushed to release its lock condition against a spring between the button and the knob **34**. When the nurse's hand is disengaged from the access port **11**, it is not forget the lock operation because the stopper is always meshed with the gear due to the biasing of the spring. Alternatively, the stopper may include a reciprocation member along the radial direction of the frames movably supported by the knob and meshed with the gear.

The stopper may be a ratchet mechanism comprising a plurality of ratchet tooth provided on the cylindrical surface of the inner frame and a pawl pivotally supported on the knob of the outer frame to allow the outer frame to be rotated in the clockwise direction. Also the ratchet pawl is biased to engage the ratchet teeth and manually release it.

The outer frame **16** may be movably supported on the inner frame **15** along the axis thereof as well as its rotation. In this case, the circular projection **30** of the outer frame **16** engaged on the guide groove **26** is moved back by backwardly pushing the outer frame **16** to fit a conical surface of the inner frame **15** having slightly increased diameters and successively integral to the groove **26** to increase the friction therebetween. Also, a knurl treatment is applied on the conical surface. Alternatively, a ring gear is provided with the circular projection **30** of the outer frame **16** to be rotated on the smooth guide groove **26** or to be meshed with a geared cylindrical surface upon backwardly pushing the outer frame **16**.

The access port **11** according to the present invention is not opened by the self-weight or movement of the respiration tube **17** or cable because the outer frame is rotated in the clockwise direction to squeeze or close the flexible sheet **14** and then the stopper is rotated in the clockwise direction or moved to the lock position. Then, the airproof in the infant incubator **10** is substantially maintained after the respiration tube **17** is inserted into the infant incubator **10** through the access port **11**.

As the stopper is provided on the outer frame or the knob thereof, the operator easily recognizes it upon rotating the outer frame to prevent the latch of the stopper from forgetting.

As the stopper on the outer frame is pressed at two point to the inner frame, no additional latch member is needed with a simple construction to prevent the rotation of the outer frame.

FIG. **5** shows a second embodiment of the access port **11** detachably mounted to an opening of the hood **13**. This hood **13** is used in several medical vessels, in this case, a transparent partition wall of the infant incubator **10**.

FIG. **6** shows a cross sectional view of the access port **11** taken in line A—A of FIG. **5**. In FIGS. **5** and **6**, similar or same members corresponding to those of FIGS. **1** to **4** are denoted same numerals, respectively.

In FIGS. **5** and **6**, the access port **11** comprises a cylindrical frame **52** moulded by a plastic material and detachably mounted on an opening of a hood **13** of the infant incubator **10**. The frame **52** includes a circular flange **22** having a ring portion abutted to the hood **13** adjacent to the opening and a cylindrical portion **23** protruded from the opening when the frame **52** is inserted from inside of the hood **13**. The flange **22** has then an outer diameter larger than that of the opening. A circular groove **24** is provided on the cylindrical portion **23** integral to the ring portion. An O-ring or snap ring **25** made of a silicon rubber and having an outer diameter larger than the diameter of the opening of the hood **13** is fitted between the circular groove **24** and the hood **13** adjacent to the opening to secure the frame **52** to the hood **13**. Then, the spacer ring **25** has an inner diameter smaller than an outer diameter of the circular groove **24** to serve as a retaining ring.

The mounting structure of the frame **52** to the hoof **13** is similar to the conventional one. Therefore, the present access port **11** can be easily substituted with the conventional access port if the size or dimension of the flange is identical.

A base plate **54** is provided or integral to the cylindrical portion **23** of the frame **52**. A rectangular opening **56** is centrally provided on the base plate **54** to manually access or handle the respiration tube **17**. This opening **56** is closed or opened by a horseshoe plate **58** moulded by a plastic material. The horseshoe plate **58** is pivotally supported through two vertical members **60** by a horizontal member **62** projected from the base plate **54**. Then, the vertical members **60** are secured by adhesives to the horseshoe plate **58** at its back side and to a holding plate **64** at its front side, respectively.

The horseshoe plate **58** has a rounded rectangular outside and an upwardly opened inside **66** which receives a shield rubber plate **68** to seal an area of the inside **66**. The shield rubber plate **68** has a crossed slit **70** to provide a plurality of individually moved resilient pieces **72**. The artificial respiration tube **17** can be passed to the infant incubator **10** through the slit **70** with a tolerable leak level even if the horseshoe plate **58** is closed the opening **56**. The holding plate **64** has a set of two grooves **74** to hold the respiration tube **17**.

The vertical members **60** carrying the horseshoe plate **58** and the holding plate **64** are pivotally supported to the horizontal member **62** positioned under the opening **56** through a pair of shafts **76**. The horseshoe plate **58** is locked or held at the closed position of the opening **56** by a lock mechanism **78**. The lock mechanism **78** includes an L-shaped or angle member **80** secured to the base plate **54** and a lock lever **82** pivotally mounted on the horseshoe plate **58**. A free end of the lock lever **82** is latched to a space provided between the angle member **80** and the base plate **54** upon closing the opening **56**.

The horseshoe plate **58** is pivotally supported at the lower portion thereof as shown in this embodiment. Then, as the horseshoe plate **58** is disposed under the opening **56** by self-weight when open the opening **56**, the horseshoe plate **58** does not interfere the manual access through the opening **56**.

Two grooves **74** are provided in the holding plate **64** to hold exhalation and inhalation tubes **17** for the artificial respirator. Each groove **74** has two opened circles each having a different radius to hold two types of the respiration tubes **17**. Then, the groove **74** has the upper inner width wider than the inner width. In this embodiment, the groove **74** has a gourd configuration viewed from the front.

The shield plate **68** made of the silicon rubber includes a thick peripheral portion attached to a rim of the upwardly opened inside **66** of the horseshoe plate **58** and a thin inner area in which the crossed slit **70** (a lateral slit **70** is shown in FIG. **6**) having a substantially zero width or gap is provided to define the plurality oh the resilient pieces **72**.

In the crossed slit **70** of the horseshoe plate **68**, vertical slit **70** (see FIG. **5**) is upwardly opened and extended from its upper rim to its lower side of the thin area to receive the respiration tube **17** from the upper rim to the crossed portion

of the slit **70** among the plurality of individually moved resilient pieces **72**. Then, when the respiration tube **17** is inserted to the infant incubator **10** through the opening **56** and then the opening **56** is closed by the horseshoe plate **58**, the portion of the respiration tube **17** is easily positioned to the plurality of individually moved resilient pieces **72** through the vertical slit **70**. Therefore, the lateral slit **70** is aligned with a virtual horizontal diameter of the upper circular groove **74**.

FIGS. **7** and **8** are sectional views similar to FIG. **6**, showing a condition in which the respiration tube **17** is inserted to the access port **11**. FIG. **7** shows a condition in which the opening **56** is closed by the horseshoe plate **58** and FIG. **8** shows a condition in which the opening **56** is opened.

As shown in FIG. **7**, the respiration tube **17** passing through among the plurality of resilient pieces **72** is firmly held by the groove **74** of the holding plate **64** of the horseshoe plate **58**. Then, even if a force is applied to the one side of the respiration tube **17** before the holding plate **64**, another side of the respiration tube **17** is not affected by such a force.

As shown in FIG. **8**, the respiration tube **17** is firmly held by the groove **74** of the holding plate **64**, even if the opening **56** is opened by pivoting the horseshoe plate **58**. Then, even if the nurse is manually operated through the opening **56**, the respiration tube **17** is not removed from the holding plate **64**, and the respiration tube **17** does not interfere the work of the nurse.

While the embodiments of the access ports according to the present invention are described as mentioned above, any modification to the construction of the access port can be made. For example, the lock mechanism **78** may include an L-shaped or angle lock lever pivotally sealingly supported on the base plate **54** and having its free end for gripping the horseshoe plate **58** associated with the base plate **54** upon pivoting to the lock position.

The holding plate **64** may include secure means for securing the respiration tube in the groove after receiving the tube by the groove to completely hold the tube. The securing means may be mechanically synchronized with the lock mechanism.

A second lateral slit **70** may be provided to be aligned with a virtual horizontal diameter of the lower circular groove **74**.

A plurality of the resilient pieces may be provided with the thin shield plate **68** having an upwardly opened vertical slit along a Y-axis, two lateral silts each successively connected to the vertical slit and extending along an X-axis between two points including virtual Z-axes of the upper or lower circular grooves **74**, and four sets of radial slits extending from the four points including the virtual Z-axes of the upper and lower circular grooves **74**. The lengths of the radial slits are substantially identical to diameters of upper and lower circular grooves, respectively.

According to this embodiment of the invention, the respiration tubes can be inserted, firmly held with the negligible leakage of the controlled air by providing the crossed slit or additional radial slits aligned with those of grooves of the holding plate.

As two types of two groove sets are prepared, plural members are efficiently inserted to the medical vessel with one access port.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, various change in the size, shape materials, components, as well as in the details of the illustrated construction and method of operation may be made without departing from the spirit of the invention.

What is claimed is:

1. An infant incubator including a transparent hood, an opening defined by said hood, and an access port mounted in said opening permitting insertion of a member into the incubator, said port being formed by:

a frame having an opening;

a horseshoe plate pivotally supported on the frame to open or close said frame opening;

a lock mechanism for locking said horseshoe plate in a closed position;

an inner side provided on the horseshoe plate;

a resilient member mounted to said horseshoe plate on said inner side;

a slit defined by the resilient member for insertion of a member, and

a holding means provided on the horseshoe plate to hold a member inserted through said slit when said horseshoe plate is in said closed position.

2. An incubator according to claim **1**, characterized in that said holding means comprises at least one groove aligned with the horseshoe plate adjacent said inner side.

3. An incubator according to claim **2** including means defined by said groove for gripping said member whereby said member is firmly held within said groove whereby said member is held by said holding means in the open or closed positions of said horseshoe plate.

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